BRIEFER ARTICLES.

The origin of the sexual organs of the Pteridophyta.—One of the greatest difficulties encountered in attempting to determine the homologies existing between bryophytes and pteridophytes has been the apparently radical differences in the structure of the sexual organs, especially the archegonium. The latter in all pteridophytes is remarkably constant in structure and always has the venter completely immersed and the neck composed of four rows of cells. In the bryophytes the venter is usually free, and the neck composed of six (sometimes five) rows of cells. These differences are especially noticeable when the leptosporangiate ferns are compared with the bryophytes, and so long as the former were regarded as primitive forms it made all attempts to connect them with any group of bryophytes seem hopeless.

When, however, the eusporangiate pteridophytes are examined, it is seen that they show certain points of resemblance in the structure of the sexual organs to one order of the Hepaticæ, the Anthoceroteæ, which has long been admitted to have the greatest affinity to the pteridophytes in the structure of the sporogonium. An examination of several members of this order in connection with the study of the development of *Marattia*, one of the eusporangiate ferns, led the writer to venture on a possible explanation of the origin of the archegonium of the latter from forms resembling the Anthoceroteæ. A further examination of other eusporangiate ferns, as well as *Equisetum* and the Lycopodineæ, makes it seem likely that the statements made with reference to *Marattia* are applicable to all pteridophytes, and that homologies in the antheridium of the eusporangiate pteridophytes and Anthoceroteæ can also be assumed with much probability.

In all bryophytes there are formed in the archegonium mother-cell three nearly vertical walls which intersect so as to enclose an axial cell from which are formed the egg and canal-cells, as well as a terminal cell, the cover cell. This latter in the Hepaticæ always divides by cross-walls into four cells which may occasionally undergo one or two further divisions. The axial row of cells is surrounded by three peripheral cells, which divide usually once by a vertical wall. Sometimes one of these fails to divide so that there are but five in all. These six (or five) cells are the initials for the corresponding rows of cells in the neck of the mature archegonium.

One group, the Anthoceroteæ, as is well known, differs very much in the appearance of the archegonium from the other Hepaticæ. Instead of projecting above the thallus it is completely sunk in it, and the limits of the neck cells are extremely obscure, while only the cover cells of the neck, or the uppermost cells of the axial row are free. A comparison of the earlier stages with the corresponding ones of the pteridophytes shows a striking resemblance, and renders the conclusion irresistible that the so-called mother cell of the archegonium of the latter is really homologous only with the axial row of cells of the bryophytic archegonium. It is equally evident that the four-rowed neck of the pteridophytic archegonium is a development of the four cap cells of the liverwort archegonium and cannot be properly compared to the six rows of neck cells in the latter. These are no longer clearly discernible but are more or less completely suppressed as in *Anthoceros*. As might be expected the departure from the bryophytic type is least marked in the Eusporangiatæ which in other respects come nearer to the Hepaticæ.

The Anthoceroteæ differ from all the other bryophytes in having the antheridium of endogenous origin. The antheridium (or antheridia) is covered by two layers of cells and the cavity within which it lies is completely closed from the first. The antheridial cell may give rise to a single antheridium, or more commonly, to a group of antheridia varying much in number even in the same species.

A study of the earlier stages, as was the case with the archegonium, shows very significant resemblances to the corresponding stages of the eusporangiate pteridophytes, and at once suggests that by a suppression of the wall and stalk of the antheridium of some form with a single antheridium, the type found in all the eusporangiate pteridophytes may have been at once formed. In the latter, the cell which in the Anthoceroteæ gives rise to the outer wall of the cavity containing the antheridia becomes at once the outer wall of the antheridium itself, while the inner one develops directly the mass of sperm cells. It is to be noted that this wall is double in some of the eusporangiate ferns, while in those that approach the Leptosporangiatæ it is single, and not infrequently projects somewhat so that the antheridium approaches the free condition found in normal Leptosporangiatæ. The greatest difficulty that remains is the origin of the multi-ciliate spermatozoids of the Filicineæ and Equisetineæ, to which, as yet, there is absolutely no clue.

In conclusion then, it seems probable that the origin of the pteridophytes is to be looked for from forms which, like *Anthoceros*, had the sexual organs completely submersed, and that the elongated archego-

nium neck and projecting antheridia of the Leptosporangiatæ are secondary developments.—DOUGLAS HOUGHTON CAMPBELL, *Berlin, Germany.*

Botanical notes (WITH PLATE VIII). — I. *The spreading of raspberry bushes by a system of natural "layering." Rubus occidentalis.*—A few observations, apparently not hitherto recorded, gave rise to the following more complete account of a process, the more general facts of which were already well known. The internodes formed by the raspberry in later summer are considerably longer than those produced earlier in the season, and bear but few prickles. This later growth becomes recurved and seeks the ground, the newer internodes being very long. After the stem has developed to a certain length in this downward direction, the newer internodes are very rapidly shortened, and the prickles become very numerous as compared with their frequency elsewhere on the stem. It was very interesting to see that when the plant grew on the sides of cliffs this shortening of internodes took place, even when the ground had not been reached, and when the growing ends of the descending branches were fully illuminated by the sun. The habit of terminating the branches at a certain length by means of the shortened internodes covered with prickles seems to have become so strong that the branches go through the process even where, owing to their growth on the side of cliffs, the normal conditions, which must have given origin to this habit—the shade and dampness formed by leaves along the ground, and the presence of loose earth into which the branches could penetrate—do not exist. The prickles towards the tips of the branches are strongly curved backwards, in decided contrast to the ordinary prickles of the plant which are fairly straight, and are placed nearly at right angles to the stem. On reaching the ground the shortened internodes curve forwards and enter it obliquely. The recurved prickles prevent the tips which are just starting root from being readily torn out of the ground, catching hold of the underbrush and weeds among which they have rooted, and hooking into the ground itself.

As the joints began to lengthen during summer, the leaves grew smaller, and by the time the newer internodes were strongly shortened, preparatory to rooting, the leaves were reduced to small scales, subtending small scaly buds. Indeed, this reduction to scales takes place even in the open air, before the ground has been reached, but is universal on the rooting part of the stem.

Towards the tip of the branches, among the shortened internodes, the stem sends out rootlets. These do not come out at any point on the stem, but occur in two pairs, at each node, just below the base of